

Broad Agency Announcement (BAA) TCBA-08-0004
DEVELOPMENT OF NONDESTRUCTIVE EVALUATION TECHNOLOGY
FOR CRITICAL AIRCRAFT ENGINE ROTATING COMPONENTS

1. Background:

This project supports the development of improved nondestructive evaluation (NDE) techniques for critical rotating components of aircraft turbine engines. These rotating components store tremendous amounts of rotational and inertial energy and pose a serious safety threat when fractured components release high-velocity disk fragments capable of penetrating the aircraft fuselage. As the aviation industry moves toward incorporation of damage tolerance concepts in the design and maintenance of propulsion systems, more challenging fatigue crack resistance and inspection requirements emerge. A number of specific advances in NDE capability, reproducibility, and reliability are needed to support future critical rotating components.

A 5-year NDE Technology Development Plan has been developed by FAA and will be used to identify specific research and development tasks. The Plan is divided by application into 5 categories:

1. NDE Method Development
2. NDE of Materials
3. NDE of As-Manufactured Parts
4. NDE of In-Service Parts
5. POD of NDE Methods

Each of these categories is focused on addressing both near-term and long-range NDE technology needs. NDE Method Development addresses advancing the development of ultrasonic and eddy current methods for application on both as-manufactured and in-service components. In addition, it addresses the need to develop automatic defect recognition tools to minimize operator impact on inspection reproducibility and reliability. NDE of Materials centers on evaluation of properties such as residual stress, bond joint strength, and residual fatigue life of nickel and titanium rotor alloys. NDE of As-Manufactured Parts concentrates on follow-on programs to the current FAA effort on NDE of manufacturing anomalies, including refinement of promising inspection methods or process monitoring to minimize generation of manufacturing process anomalies. NDE of In-Service Parts is aimed at development of new or modified surface defect inspection techniques to replace or augment the current fluorescent penetrant inspection (FPI). The POD of NDE Methods looks at developing analytical models and solutions for quantifying the POD of the growing number of inspection methods that produce images rather than simple numerical results.

2. Purpose

The purpose of this BAA is to solicit interest in the form of research proposal briefs from the NDE community. These 2 page briefs should offer practical and achievable solutions to the inspection-related challenges posed by the next generation of jet engines. These challenges include but are not limited to these following areas identified in the FAA 5-yr Plan:

- a. New NDE techniques capable of evaluating the bond joint strength and mechanical integrity of advanced engine rotating components such as BLISKs and Dual-Alloy Disks.
- b. Fast, low-cost, large area inspection methods to detect surface anomalies in in-service critical rotating components. Proposed methods should be more cost effective than current eddy current methods with the capability to detect 20 X 10 mil crack size anomalies with a 90/95 probability of detection.
- c. Development of computer generated data analysis algorithms that automatically evaluate amplitude and signal-to-noise rejections without operator intervention. Development of this capability for inspections such as UT of forgings, EC image analysis, Sonic IR image evaluation, and FPI image analysis. A series of programs is envisioned, each aimed at developing computer driven auto defect recognition for one of the previously mentioned NDE methods.
- d. New sensors for monitoring a complex machining process, such as broaching, to minimize the possibility of producing a manufacturing induced anomaly in the finish machined component.
- e. Development of NDE techniques capable of quantifying the residual stress profile in a shot-peened titanium component to depths of 0.015" or more.
- f. New, innovative and cost effective ultrasonic methods with faster speed and detection capabilities at least 4 times better than the current titanium forging inspection techniques. Especially sought are approaches that exploit stochastic NDE techniques to improve signal-to-noise ratio, permit inspection of complex near-net shape geometries, and reduce inspection variability.
- g. Develop new and innovative approaches to POD data analysis techniques and curve generation from image producing NDE methods.

Submitted proposal briefs should focus on solutions to one or more of the above challenges.

3. Submission Deadlines

Technical proposal briefs (see section 4) prepared in accordance with this synopsis will be accepted through 30 Jun 2008. Upon request of the FAA, formal proposals shall be submitted within 45 calendar days after the date of the request. This request will be made via email and letter.

4. Submission Requirements

Offerors will submit two-page technical proposal briefs addressing the areas of their interest listed above prior to submitting a formal proposal. The two page technical brief shall meet the requirements described below in paragraph 5. Mail the two page technical summaries to:

FAA
William J. Hughes Technical Center
Code AJP-6360 (Attn: Cu Nguyen)
Atlantic City Int'l Airport, NJ 08405

In addition (not as a substitute for the paper copy), an electronic version of the proposal brief will be emailed to cu.nguyen@faa.gov. The electronic version shall be provided in Microsoft Word or Adobe Acrobat format.

No later than 45 days after receipt of the two page technical proposal brief, the FAA will respond to offerors in one of four ways:

- a. Request for the submission of a formal proposal.
- b. Recommendation to submit a formal proposal if certain changes are made or conditions met.
- c. Notification that the white paper was good but due to insufficient funding, a formal proposal request is delayed until the next FY.
- d. Rejection of the summary proposal and no request for a formal proposal.

If requested by the FAA, the offeror shall submit a formal proposal, containing a detailed discussion of the subject presented in the two page proposal brief. The formal proposal shall address the requirements described in the 'Formal Proposal Requirements' section of this announcement. The formal proposal will be mailed to the FAA at the same address as the summary proposal. An electronic copy must also be provided.

5. Two-Page Technical Summary Requirements

There is no specific format for the two page technical summary. The summary may be preceded by a cover letter, but the cover letter will not be considered in the evaluation, nor will pages in excess of two be considered. At a minimum the summary shall contain the following items:

- a. The specific purpose of the proposed research;
- b. A description of the proposed research;
- c. Information regarding the interest or endorsement from the airline industry including but not limited to engine OEMs, airline carriers, and repair stations;
- d. The current state of development of the proposed research;
- e. The estimate time it would take to complete the proposed research;
- f. A description of any proposed testing and evaluation procedures for the proposed research; and
- g. The estimated funds required for the proposed effort.

6. Formal Proposal Requirements

Formal proposals will only be submitted at the request of the FAA and must be received no later than 45 calendar days after the request date. Formal proposals shall consist of separate technical and cost proposals and must comply with the requirements listed here..

- a. Offerors shall describe in full detail, the technique involved, and whether equipment, transducers, sensors, etc need to be developed. Details should include:
 1. Engine type, component to be inspected, material to be inspected
 2. Damage and flaw type to be found
 3. Location and size of flaw to be found
 4. The current and projected ending TRL (technology readiness level) of the project, equipment and/or technique
 5. Any special or unique operating conditions required to support the application of the proposed technology
 6. Any relevant Probability of Detection (POD) data in existence or to be completed
- b. Offerors must identify a partner within the aviation community (i.e., an engine OEM, aircraft operator, or repair station) who will serve as an advisor and advocate for the effort. Proof of commitment, such as a letter of intent, by the partner will be provided with the proposal. The proof need not be a contract. Matching funds or services-in-kind from the partner are not required but will be considered positively during proposal evaluation.
- c. Offerors shall propose to the FAA a validation plan, which includes blind testing. If possible, validation will be performed at Airworthiness Assurance NDI Validation Center (AANC) in Albuquerque, NM using existing sample sets or other inspection facilities. Use of existing sample sets are free of charge. If the sample sets are not suitable to the validation of the proposed technology, address the rationale for this conclusion and provide an alternative plan for validation. Alternatives will likely include obtaining applicable test specimens from a willing aviation industrial partner. The proposal will address all costs related to the validation effort.
- d. Offerors shall prepare an implementation and technology transfer plan, describing how the proposed technology will be developed into commercial products or practices that are practical for use in the inspection and maintenance of existing aircraft in the commercial fleet.
- e. The proposal shall identify all areas of risk related to development, implementation, and technology transfer, of the proposed system, technology, or technique. The proposal shall include mitigating strategies for each risk area. Proposals that do not identify risk areas will be considered non-developmental in nature and therefore outside the scope of this research.

program. Implementation risks are associated with logistical issues, missing/inadequate support infrastructure, etc.

7. Method of Evaluation

Proposals will be evaluated in the five technical areas listed in order

- a. Technical merit.
- b. Utility to the FAA/aircraft OEMs/airline industry.
- c. Investigative team competency, NDI experience, and partnership/collaboration.
- d. Effective plan for project completion.
- e. Technical risk.

Cost and cost realism will be evaluated as acceptable or unacceptable only. Acceptable proposals in each area above will have costs commensurate with the work load proposed. Any proposal that exceeds \$200,000 in one year may not be considered due to funding constraints.

8. Period of Performance:

Efforts lasting between one and two years have much better chance to be considered. Multi-year efforts will be funded in yearly increments, providing measurable and adequate performance is shown prior to each new funding increment.